Line/Register Signaling (R1/R2 MF) for TMS320C6201† Overview Guide

www.radisys.com

World Headquarters
5445 NE Dawson Creek Drive • Hillsboro, OR
97124 USA
Phone: 503-615-1100 • Fax: 503-615-1121
Toll-Free: 800-950-0044

International Headquarters
Gebouw Flevopoort • Televisieweg 1A
NL-1322 AC • Almere, The Netherlands
Phone: 31 36 5365595 • Fax: 31 36 5365620

007-01052-0002
November 2000

November 2000
Copyright ©2000 by RadiSys Corporation.
All rights reserved.

EPC, iRMX, INtime, Inside Advantage, and RadiSys are registered trademarks of RadiSys Corporation. Spirit, DAI, DAQ, ASM, Brahma, and SAIB are trademarks of RadiSys Corporation.

† All other trademarks, registered trademarks, service marks, and trade names are the property of their respective owners.

Line/Register Signaling (R1/R2 MF) for TMS320C6201

The Line/Register Signaling (R1/R2 MF) for TMS320C6201† performs R1/R2 detection for high capacity trunks. It detects only in-band audible tones; it does not address any tones which may be out-of band.

The R1/R2 MF executes on blocks of 80 linear 16-bit PCM samples (10ms frames at 8000Hz sampling rate) and can be called with the APIs defined in this document. You can use the R1/R2 MF software in a multi-tasking environment.

For information about installing and using the R1/R2 MF software, see the topics listed below.

For information about...	Go to this page...
Installation	1
Requirements	2
Install the software	2
Compile and link the software	2
Application programmer interface	4
CreateToneDet(pTdVar)	4
Testing and performance specifications	6
Where to get more information	14

Installation

To make the R1/R2 MF software fully functional, follow these steps:

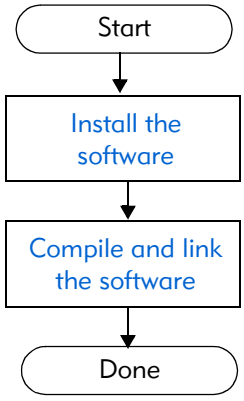

Figure 1. Installing and building the R1/R2 MF software

Requirements

Before you can install this software, you need the following:

- A Microsoft† Windows† 95 or Windows NT† compatible PC platform.
- The following software installed on your computer:
  - TMS320C6x Code Generation Tools Release 3.01 for Windows 95 or Windows NT

    —or—

    Code Composer Studio Tools, version 1.2, for Windows 95 or Windows NT.
  - NMAKE utility (available from Microsoft).
  - PKUNZIP utility.

Install the software

To install the R1/R2 MF software:

1. Create a directory on the target system. For example:

   ```
   mkdir c:\r1r2mf
   ```

2. Copy the product files from the CD-ROM to the directory you just created.

Use a copy utility that retains the directory structure, such as Xcopy.

Compile and link the software

To compile and link the R1/R2 MF software:

1. Open an MS DOS command prompt window and go to the target directory, then go to the /c6xsim sub-subdirectory.
2. If you've already installed the TI tools, you can build the C6x version of the R1/R2 MF by entering this command at the MS DOS command prompt:

   ```
   NMAKE -f r1r2bld.mak
   ```

The directory contains test vector file tonefile.pcm. When the program r1r2c6x.out is executed, this test vector is executed and the results of the output is in tonefile.c6x. This result should be the same as those in file tonefile.pc

Code organization

When installed, the R1/R2 MF software files reside in this directory structure:

Directory	Extension	File type	Description
\r1r2mf		Manual, release notes	This guide, in PDF format, and release notes.
\r1r2mf\c6xsim		Control source and executable for C6x	
	.c	C files	r1r2mfc6x.c. is a control source file.
	.c6x	Output files	tonefile.c6x is an output file.
	.cmd	Linker command files	The r1r2mfc6x.cmd file controls object modules, linking options, and memory maps for the R1/R2 MF module.
	.lib	Library files	The r1r2mf.lib file includes object modules used to build DSP executables.
	.mak	Build file	The r1r2bld.mak file[1] controls the build process.
	.pc		Includes tonefile.pc, expected results for tonefile.pcm.
	.pcm		Includes tonefile.pcm, a binary 16-bit PCM input file.
\r1r2mf\include	.h	Header files	Header files used to build the R1/R2 MF. Applications can share these files as well.

[1] This file is tested to work with the Microsoft NMAKE utility, and can be modified to work with other make utilities.

Demo program

A demo program, r1r2c6x.c, is included on the CD-ROM.

In the demo program, the Data Structures are created for a single channel. The CreateToneDet(pTdVar) function initializes the R1/R2 state variable data structure. The ToneDetMain () needs to be called once every 10 ms time slot. The R1 or R2 key, if detected, is in the *pTdVar->key* element of the state variable structure. For multiple channels, multiple instances of data structures have to be allocated on a per-channel basis. The same set of coefficients can be used for all the channels.

See the demo program for tone detector tables/coefficient structure(pTdCoeff) initialization and API executions.

Application programmer interface

Once you've installed and built the R1/R2 MF software, you can use the R1/R2 MF functions in your C application code.

The R1/R2 MF functions accept buffers passed to the module (for example, no stack variables, and no direct access of globals).

CreateToneDet(pTdVar)

This function:

- Executes the tone detector module, configuring appropriate parameters for the detector and initializing variables.
- Runs:
  - A spectral analysis on the new *PCMBuf* of data.
  - A heuristic machine on the results of the spectral analysis.
  - A state machine and report results in the *pTdVar* structure.

Syntax

```
ToneDetMain(
pTdVar,
PCMBuf,
pTdCoeff,
BUF_SZ,
PROC_SZ,
maScale,
State
)
```

Parameters

pTdVar Pointer to *pTdVar*, the R1/R2 MF detector state variable structure, 32-bit aligned, size of (r1r2mfStateVar), persistent memory. The *pTdVar->key* element defines the key number

pTdCoeff Pointer to R1/R2 MF detector state table structure, 16-bit aligned, size of (r1r2mfTbl), shared memory.

PCMBuf 16-bit linear PCM input data buffer pointer, 16-bit aligned, 160 bytes (80 samples), non-persistent memory.

BUF_SZ Number of input samples processing at once (Frame size=80). No other size is applicable in this version.

PROC_SZ Spectral Estimator block size (256). No other size is applicable in this version.

maScale Scratch buffer, size of 2,048 bytes, 32-bit aligned, scratch memory.

State Detector State short variable. Values include:

0 R1

1 R2

Key definitions

State ('0') for R1, '1' for R2)	Key number (pTdVar->key)	Key representation	Signal	Frequencies detected (Hz)
R1 Line	0	R1KEY0	Line	2600
R1 Register	1	R1KEY1	KP	1100,1700
R1 Register	2	R1KEY2	Digit 1	700,900
R1 Register	3	R1KEY3	Digit 2	700,1100
R1 Register	4	R1KEY4	Digit 3	900,1100
R1 Register	5	R1KEY5	Digit 4	700,1300
R1 Register	6	R1KEY6	Digit 5	900,1300
R1 Register	7	R1KEY7	Digit 6	1100,1300
R1 Register	8	R1KEY8	Digit 7	700,1500
R1 Register	9	R1KEY9	Digit 8	900,1500
R1 Register	10	R1KEY10	Digit 9	1100,1500
R1 Register	11	R1KEY11	Digit 0	1300,1500
R1 Register	12	R1KEY12	ST	1500,1700
R1 Register	13	R1KEY13	ST1	700,1700
R1 Register	14	R1KEY14	ST2	900,1700
R1 Register	15	R1KEY15	ST3	1300,1700
R2 Register	0	FR2KEY0		
R2 Register	1	FR2KEY1	Forward	1380,1500
R2 Register	2	FR2KEY2	Forward	1380,1620
R2 Register	3	FR2KEY3	Forward	1500,1620
R2 Register	4	FR2KEY4	Forward	1380,1740
R2 Register	5	FR2KEY5	Forward	1500,1740
R2 Register	6	FR2KEY6	Forward	1620,1740
R2 Register	7	FR2KEY7	Forward	1380,1860
R2 Register	8	FR2KEY8	Forward	1500,1860
R2 Register	9	FR2KEY9	Forward	1620,1860
R2 Register	10	FR2KEY10	Forward	1740,1860
R2 Register	11	FR2KEY11	Forward	1380,1980
R2 Register	12	FR2KEY12	Forward	1500,1980
R2 Register	13	FR2KEY13	Forward	1620,1980
R2 Register	14	FR2KEY14	Forward	1740,1980
R2 Register	15	FR2KEY15	Forward	1860,1980
R2 Register	16	BR2KEY0		
R2 Register	17	BR2KEY1	Backward	1140,1020
R2 Register	18	BR2KEY2	Backward	1140,900
R2 Register	19	BR2KEY3	Backward	1020,900
R2 Register	20	BR2KEY4	Backward	1140,780
R2 Register	21	BR2KEY5	Backward	1020,780

State ('0') for R1, '1' for R2)	Key number (pTdVar->key)	Key representation	Signal	Frequencies detected (Hz)
R2 Register	22	BR2KEY6	Backward	900,780
R2 Register	23	BR2KEY7	Backward	1140,660
R2 Register	24	BR2KEY8	Backward	1020,660
R2 Register	25	BR2KEY9	Backward	900,660
R2 Register	26	BR2KEY10	Backward	780,660
R2 Register	27	BR2KEY11	Backward	1140,540
R2 Register	28	BR2KEY12	Backward	1020,540
R2 Register	29	BR2KEY13	Backward	900,540
R2 Register	30	BR2KEY14	Backward	780,540
R2 Register	31	BR2KEY15	Backward	660,540

Testing and performance specifications

The TMS320C6x R1/R2 MF implementation must satisfy IUT-T specifications by passing all the tests outlined in the ITU-T Q.400 to Q.490 for R2 signaling and ITU-T Q.31- to Q.331 for R1 signaling. These tests are performed using the c6x evaluation board and standard file I/O. Results should be compared directly against test requirements.

R1 signaling

The Signaling System R1 is used for inter-register signaling, primarily in North America. It consists of two parts: line signaling for line and supervisory signals, and register signaling for address signals.

R1 line signaling

The R1 lind signaling will not be considered here because the R1 signaling will be operated in a digital transmission environment where all line signaling is handled via signaling bits. However, TASK-6000 provides APIs to detect the signaling bits from digital transmission equipment such as E1/T1 framers (See *TASK-6000* on page 14). APIs provide the ABCD information bits through which line signalind can be detected by mapping.

R1 register signaling

R1 Register Signaling uses MF in-band pulse signaling for the transmission of address information. The signaling frequencies used are 700 Hz to 1700 Hz, in 200 Hz steps. Combinations of two, and only two, determine the signal.

R2 signaling

The Signaling System R2 is listed by ITU-T as a European signaling code. It also consists of both line signaling and inter-register signaling parts.

R2 line signaling

The R2 line signaling will not be considered here because the R2 signaling will be operated in a digital transmission environment where all line signaling is handled via signaling bit. However, TASK-6000 provides APIs to detect the signaling bits from digital transmission equipment such as E1/T1 framers (see *TASK-6000* on page 14). APIs provide the ABCD information bits through which line signaling can be detected by mapping.

R2 inter-register signals

Each inter-register signal consists of the simultaneous sending of two in-band frequencies, out of a range of 6, 5, or 4. The system uses two different sets of 6 frequencies for the composition of the forward and backward signals.

Running R1/R2 MF tone detector tests on Texas Instruments evaluation board

To run the tone detector tests, use the fixed-point TMS320C6x program r1r2c6x.out, which can be run using the TI evaluation board along with Code Composer Studio Tools, version 1.2, from the c:\r1r2mf\c6xsim directory. The input PCM file is expected to be in tonefile.pcm, and the output file tonefile.c6x is generated in the same directory. The output consists of the Detected Key number (int) along with a time stamp (short). Actual Key detected time is equal to 10 ms times the time stamp.

R1/R2 MF tone detector initialization

R1/R2 MF uses the constants specified in c:\r1r2mf\include\r1r2def.h which specifies frequencies, cadences, and tolerance for detection. The User has an option to configure the tone detector at run time to detect R1 MF tones by setting the structure variable (pVar->keyState) to '0'(default). Similarly, to detect R2 MF tones, set the structure variable (pVar->keyState) to '1'. The tone detector state machine then looks for the user specified tones for detection.

Test results on R1/R2 MF tone detector

All the tests have been performed on R1/R2 MF tone detector through the standard file I/O using the Texas Instruments c6x emulator. It was confirmed that the 'C6x implementation was a bit-exact match of the RadiSys fixed-point C simulation. The results of these tests are presented in what follows.

Test (Key no.)	Freq (Hz)	Freq Dev (%)	SNR (dB)	Twist (dB)	Sig Lev (dBm)	Input file	Detect
R1 Line Signaling (0)	2600					2600tone.pcm	YES
		-15Hz				2585tone.pcm	YES
		+15Hz				2615tone.pcm	YES
			12			2600tone_snr.pcm	YES
					-30	2600tone_dnr.pcm	YES
R1 Register Signaling (1)	700, 900					700_900tone.pcm	YES
		+1.5				700_900tone_fdp.pcm	YES
		-1.5				700_900tone_fdn.pcm	YES
				+6		700_900tone_tw1.pcm	YES
				-6		700_900tone_tw2.pcm	YES
					-30	700_900tone_dnr.pcm	YES
			12			700_900tone_snr.pcm	YES
R1 Register Signaling (2)	700, 1100					700_1100tone.pcm	YES
					-30	700_1100tone_dnr.pcm	YES
			12			700_1100tone_snr.pcm	YES
R1 Register Signaling (3)	700, 1300					700_1300tone.pcm	YES
					-30	700_1300tone_dnr.pcm	YES
			12			700_1300tone_snr.pcm	YES
R1 Register Signaling (4)	700, 1500					700_1500tone.pcm	YES
					-30	700_1500tone_dnr.pcm	YES
			12			700_1500tone_snr.pcm	YES
R1 Register Signaling (5)	700, 1700					700_1700tone.pcm	YES
					-30	700_1700tone_dnr.pcm	YES
			12			700_1700tone_snr.pcm	YES
R1 Register Signaling (6)	900, 1100					900_1100tone.pcm	YES
					-30	900_1100tone_dnr.pcm	YES
			12			900_1100tone_snr.pcm	YES
R1 Register Signaling (7)	900, 1300					900_1300tone.pcm	YES
					-30	900_1300tone_dnr.pcm	YES
			12			900_1300tone_snr.pcm	YES
R1 Register Signaling (8)	900, 1500				0	900_1500tone.pcm	YES
					-3	900_1500tone_dnr.pcm	YES
			12			900_1500tone_snr.pcm	YES
R1 Register Signaling (9)	900, 1700					900_1700tone.pcm	YES
					-30	900_1700tone_dnr.pcm	YES
			12			900_1700tone_snr.pcm	YES
R1 Register Signaling (10)	1100, 1300					1100_1300tone.pcm	YES
		+1.5				1100_1300tone_fdp.pcm	YES
		-1.5				1100_1300tone_fdn.pcm	YES
				+6		1100_1300tone_tw1.pcm	YES
				-6		1100_1300tone_tw2.pcm	YES
					-30	1100_1300tone_dnr.pcm	YES
			12			1100_1300tone_snr.pcm	YES

Test (Key no.)	Freq (Hz)	Freq Dev (%)	SNR (dB)	Twist (dB)	Sig Lev (dBm)	Input file	Detect
R1 Register Signaling (11)	1100, 1500		12		-30	1100_1500tone.pcm 1100_1500tone_dnr.pcm 1100_1500tone_snr.pcm	YES YES YES
R1 Register Signaling (12)	1100, 1700		12		-30	1100_1700tone.pcm 1100_1700tone_dnr.pcm 1100_1700tone_snr.pcm	YES YES YES
R1 Register Signaling (13)	1300, 1500		12		-30	1300_1500tone.pcm 1300_1500tone_dnr.pcm 1300_1500tone_snr.pcm	YES YES YES
R1 Register Signaling (14)	1300, 1700		12		-30	1300_1700tone.pcm 1300_1700tone_dnr.pcm 1300_1700tone_snr.pcm	YES YES YES
R1 Register Signaling (15)	1500, 1700	+1.5 -1.5	12	+6 -6	-30	1500_1700tone.pcm 1500_1700tone_fdp.pcm 1500_1700tone_fdn.pcm 1500_1700tone_tw1.pcm 1500_1700tone_tw2.pcm 1500_1700tone_dnr.pcm 1500_1700tone_snr.pcm	YES YES YES YES YES YES YES
R2 Forward Register Signaling (1)	1380,1500	+10Hz -10Hz	12	+5 -5	-30	1380_1500tone.pcm 1380_1500tone_fdp.pcm 1380_1500tone_fdn.pcm 1380_1500tone_tw1.pcm 1380_1500tone_tw2.pcm 1380_1500tone_snr.pcm 1380_1500tone_dnr.pcm	YES YES YES YES YES YES YES
R2 Forward Register Signaling (2)	1380,1620		12	+7 -7	-30	1380_1620tone.pcm 1380_1620tone_tw1.pcm 1380_1620tone_tw2.pcm 1380_1620tone_snr.pcm 1380_1620tone_dnr.pcm	YES YES YES YES YES
R2 Forward Register Signaling (3)	1380,1740		12	+7 -7	-30	1380_1740tone.pcm 1380_1740tone_tw1.pcm 1380_1740tone_tw2.pcm 1380_1740tone_snr.pcm 1380_1740tone_dnr.pcm	YES YES YES YES YES
R2 Forward Register Signaling (4)	1380,1860		12	+7 -7	-30	1380_1860tone.pcm 1380_1860tone_tw1.pcm 1380_1860tone_tw2.pcm 1380_1860tone_snr.pcm 1380_1860tone_dnr.pcm	YES YES YES YES YES

Test (Key no.)	Freq (Hz)	Freq Dev (%)	SNR (dB)	Twist (dB)	Sig Lev (dBm)	Input file	Detect
R2 Forward	1380,19					1380_1980tone.pcm	YES
Register	80			+7		1380_1980tone_tw1.pcm	YES
Signaling				-7		1380_1980tone_tw2.pcm	YES
(5)			12			1380_1980tone_snr.pcm	YES
					-30	1380_1980tone_dnr.pcm	YES
R2 Forward	1500,16					1500_1620tone.pcm	YES
Register	20			+7		1500_1620tone_tw1.pcm	YES
Signaling				-7		1500_1620tone_tw2.pcm	YES
(6)			12			1500_1620tone_snr.pcm	YES
					-30	1500_1620tone_dnr.pcm	YES
R2 Forward	1500,17					1500_1740tone.pcm	YES
Register	40			+7		1500_1740tone_tw1.pcm	YES
Signaling				-7		1500_1740tone_tw2.pcm	YES
(7)			12			1500_1740tone_snr.pcm	YES
					-30	1500_1740tone_dnr.pcm	YES
R2 Forward	1500,18					1500_1860tone.pcm	YES
Register	60			+7		1500_1860tone_tw1.pcm	YES
Signaling (8)				-7		1500_1860tone_tw2.pcm	YES
			12			1500_1860tone_snr.pcm	YES
					-30	1500_1860tone_dnr.pcm	YES
R2 Forward	1500,19					1500_1980tone.pcm	YES
Register	80			+7		1500_1980tone_tw1.pcm	YES
Signaling (9)				-7		1500_1980tone_tw2.pcm	YES
			12			1500_1980tone_snr.pcm	YES
					-30	1500_1980tone_dnr.pcm	YES
R2 Forward	1620,17					1620_1740tone.pcm	YES
Register	40	+10Hz				1620_1740tone_fdp.pcm	YES
Signaling		-10Hz				1620_1740tone_fdn.pcm	YES
(10)				+5		1620_1740tone_tw1.pcm	YES
				-5		1620_1740tone_tw2.pcm	YES
			12			1620_1740tone_snr.pcm	YES
					-30	1620_1740tone_dnr.pcm	YES
R2 Forward	1620,18					1620_1860tone.pcm	YES
Register	60			+7		1620_1860tone_tw1.pcm	YES
Signaling				-7		1620_1860tone_tw2.pcm	YES
(11)			12			1620_1860tone_snr.pcm	YES
					-30	1620_1860tone_dnr.pcm	YES
R2 Forward	1620,19					1620_1980tone.pcm	YES
Register	80			+7		1620_1980tone_tw1.pcm	YES
Signaling				-7		1620_1980tone_tw2.pcm	YES
(12)			12			1620_1980tone_snr.pcm	YES
					-30	1620_1980tone_dnr.pcm	YES

Test (Key no.)	Freq (Hz)	Freq Dev (%)	SNR (dB)	Twist (dB)	Sig Lev (dBm)	Input file	Detect
R2 Forward Register Signaling (13)	1740,1860					1740_1860tone.pcm	YES
				+7		1740_1860tone_tw1.pcm	YES
				-7		1740_1860tone_tw2.pcm	YES
			12			1740_1860tone_snr.pcm	YES
					-30	1740_1860tone_dnr.pcm	YES
R2 Forward Register Signaling (14)	1740,1980					1740_1980tone.pcm	YES
				+7		1740_1980tone_tw1.pcm	YES
				-7		1740_1980tone_tw2.pcm	YES
			12			1740_1980tone_snr.pcm	YES
					-30	1740_1980tone_dnr.pcm	YES
R2 Forward Register Signaling (15)	1860,1980					1860_1980tone.pcm	YES
		+10Hz -10Hz				1860_1980tone_fdp.pcm	YES
						1860_1980tone_fdn.pcm	YES
				+5		1860_1980tone_tw1.pcm	YES
				-5		1860_1980tone_tw2.pcm	YES
			12			1860_1980tone_snr.pcm	YES
					-30	1860_1980tone_dnr.pcm	YES
R2 Backward Register Signaling (16)	1140,1020					1140_1020tone.pcm	YES
		+10Hz -10Hz				1140_1020tone_fdp.pcm	YES
						1140_1020tone_fdn.pcm	YES
				+5		1140_1020tone_tw1.pcm	YES
				-5		1140_1020tone_tw2.pcm	YES
			12			1140_1020tone_snr.pcm	YES
					-30	1140_1020tone_dnr.pcm	YES
R2 Backward Register Signaling (17)	1140,900					1140_900tone.pcm	YES
				+7		1140_900tone_tw1.pcm	YES
				-7		1140_900tone_tw2.pcm	YES
			12			1140_900tone_snr.pcm	YES
					-30	1140_900tone_dnr.pcm	YES
R2 Backward Register Signaling (18)	1140,780					1140_780tone.pcm	YES
				+7		1140_780tone_tw1.pcm	YES
				-7		1140_780tone_tw2.pcm	YES
			12			1140_780tone_snr.pcm	YES
					-30	1140_780tone_dnr.pcm	YES
R2 Backward Register Signaling (19)	1140,660					1140_660tone.pcm	YES
				+7		1140_660tone_tw1.pcm	YES
				-7		1140_660tone_tw2.pcm	YES
			12			1140_660tone_snr.pcm	YES
					-30	1140_660tone_dnr.pcm	YES
R2 Backward Register Signaling (20)	1140,540					1140_540tone.pcm	YES
				+7		1140_540tone_tw1.pcm	YES
				-7		1140_540tone_tw2.pcm	YES
			12			1140_540tone_snr.pcm	YES
					-30	1140_1020tone_dnr.pcm	YES

Test (Key no.)	Freq (Hz)	Freq Dev (%)	SNR (dB)	Twist (dB)	Sig Lev (dBm)	Input file	Detect
R2 Backward Register Signaling (21)	1020,900					1020_900tone.pcm	YES
				+7		1020_900tone_tw1.pcm	YES
				-7		1020_900tone_tw2.pcm	YES
			12			1020_900tone_snr.pcm	YES
					-30	1020_900tone_dnr.pcm	YES
R2 Backward Register Signaling (22)	1020, 780					1020_780tone.pcm	YES
				+7		1020_780tone_tw1.pcm	YES
				-7		1020_780tone_tw2.pcm	YES
			12			1020_780tone_snr.pcm	YES
					-30	1020_780tone_dnr.pcm	YES
R2 Backward Register Signaling (23)	1020,660					1020_660tone.pcm	YES
				+7		1020_660tone_tw1.pcm	YES
				-7		1020_660tone_tw2.pcm	YES
			12			1020_660tone_snr.pcm	YES
					-30	1020_660tone_dnr.pcm	YES
R2 Backward Register Signaling (24)	1020,540					1020_540tone.pcm	YES
				+7		1020_540tone_tw1.pcm	YES
				-7		1020_540tone_tw2.pcm	YES
			12			1020_540tone_snr.pcm	YES
					-30	1020_540tone_dnr.pcm	YES
R2 Backward Register Signaling (25)	900, 780					900_780tone.pcm	YES
		+10Hz				900_780tone_fdp.pcm	YES
		-10Hz				900_780tone_fdn.pcm	YES
				+5		900_780tone_tw1.pcm	YES
				-5		900_780tone_tw2.pcm	YES
			12			900_780tone_snr.pcm	YES
					-30	900_780tone_dnr.pcm	YES
R2 Backward Register Signaling (26)	900, 660					900_660tone.pcm	YES
				+7		900_660tone_tw1.pcm	YES
				-7		900_660tone_tw2.pcm	YES
			12			900_660tone_snr.pcm	YES
					-30	900_660tone_dnr.pcm	YES
R2 Backward Register Signaling (27)	900, 540					900_540tone.pcm	YES
				+7		900_540tone_tw1.pcm	YES
				-7		900_540tone_tw2.pcm	YES
			12			900_540tone_snr.pcm	YES
					-30	900_540tone_dnr.pcm	YES
R2 Backward Register Signaling (28)	780, 660					780_540tone.pcm	YES
				+7		780_540tone_tw1.pcm	YES
				-7		780_540tone_tw2.pcm	YES
			12			780_540tone_snr.pcm	YES
					-30	780_540tone_dnr.pcm	YES

Test (Key no.)	Freq (Hz)	Freq Dev (%)	SNR (dB)	Twist (dB)	Sig Lev (dBm)	Input file	Detect
R2 Backward Register Signaling (29)	780, 540					780_540tone.pcm	YES
				+7		780_540tone_tw1.pcm	YES
				-7		780_540tone_tw2.pcm	YES
			12			780_540tone_snr.pcm	YES
					-30	780_540tone_dnr.pcm	YES
R2 Backward Register Signaling (30)	660, 540					660_540tone.pcm	YES
		+10Hz				660_540tone_fdp.pcm	YES
		-10Hz				660_540tone_fdn.pcm	YES
				+5		660_540tone_tw1.pcm	YES
				-5		660_540tone_tw2.pcm	YES
			12			660_540tone_snr.pcm	YES
					-30	660_540tone_dnr.pcm	YES

TMS320C6x implementation processor load tests

MCPS measurements for R1/R2 MF tone detector

The following table contains MCPS (million cycles per second) measurements for the current c6x implementation of the R1/R2 MF (with hand-optimization of most of the routines) tone detector.

Operation	Ins.Cycles / Frame
Tone Spotting	444
Block Copy	140
Power Estimation	221
FFT Windowing	209
128-point Complex FFT	1969
Real FFT extraction	552
Computation FFT Magnitude	693
Bit Reversing	271
Key Decoding	1289
CPM State Machine with other Control	120
Total:	5908[1]

[1] This figure of 5908 instruction cycles per (10.0 msec.) frame translates to 0.59 MCPS per channel at an 8000 KHz sampling rate.

Memory measurements for R1/R2 MF tone detector

C6x implementation of the R1/R2 MF tone detector needs 13.28 Kbytes of program memory, and 2.312 Kbytes of data memory. Out of 2.312 Kbytes of data memory, the variables structure is of 0.728 Kbytes which should be aligned to 32-bit word boundary and tables structure is of 1.584 Kbytes which needs 16-bit alignment. In addition to the above data memory, it also needs a scratch data memory of 2.048 Kbytes.

Where to get more information

About the Line/Register Signaling (R1/R2 MF) for TMS320C6201

You can find out more about the R1/R2 MF from these sources:

- **Readme file:** Lists features and issues that arose too late to include in other documentation.
- **World Wide Web:** RadiSys maintains an active site on the World Wide Web. The site contains current information about the company and locations of sales offices, new and existing products, contacts for sales, service, and technical support information. You can also send e-mail to RadiSys using the web site.

When sending e-mail for technical support, please include information about both the hardware and software, plus a detailed description of the problem, including how to reproduce it.

To access the RadiSys web site, enter this URL in your web browser:
`http://www.radisys.com`

Requests for sales, service, and technical support information receive prompt response.

About related products

SP6040

The RadiSys SP6040 (SPIRIT™-6040 CompactPCI† board) is a high-performance intelligent I/O subsystem designed for telecom and datacom applications. Based on Texas Instruments† devices, the SP6040 has a 200MHz DSP engine with an I/O connector that provides interface-to-digital network interfaces (DNI) such as E1/T1 and ATM. The SP6040 contains up to four TMS320C6201 digital signal processors.

SP6020

The RadiSys SP6020 (SPIRIT-6020 board) features two Texas Instruments TMS320C6201B fixed-point DSPs that run at 200MHz and serve as the main processing engines. Each c6x can deliver up to 1600 MIPS of processing power, contingent on the available parallelism within the application code. The DSPs are used for voice and data processing, compression, and decompression.

TASK-6000

TASK-6000 software is a tool set that provides a framework for composing, executing and dynamically configuring optimized real-time TMS320C62x DSP applications. The Voice Gateway Platform (VGP), available from RadiSys, is used as the reference hardware platform.

For detailed information about TASK-6000 products, see the following publications:

TASK-6000 User's Manual, (07-0992-xx)

TASK-6000 Installation Guide, (07-1000-xx)

TI tools

Software tools from Texas Instruments used to build DSP executables.

For more information about Texas Instruments products, enter this URL in your web browser:
`http://www.ti.com/dsp`